LEACH

A FEDERAL SIGNAL COMPANY

SERVICE MANUAL SUPPLEMENT
Automated Side Loader
Crocodile
with CAT Operating System

STRONGER ALL AROUND

Automated Side Loader
Crocodile
with Caterpillar electronic system
Supplement Manual

TROUBLESHOOTING

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1. Introduction

Troubleshooting is an organized study of the problem and a planned method of investigation and correction.

Think about the following before proceeding:

- Quiz the operator
- What were the warning signs prior to failure?
- Ensure components and wiring are installed per factory specifications
- Do not rule out previous failed attempts
- Work through troubleshooting charts methodically
- Check the obvious things first. Keep it simple
- Many problems can be traced not to one part alone, but to the relationship of one part to another
- For multiple electrical faults, check the common ground locations, common harnesses and power supply
- Learn to read the schematics
- Identify hydraulic system heat build-up using an infra red sensor
- Carry out flow, vacuum and pressure test to hydraulic systems before removing components
- Use the Troubleshooting Guide as a reference only; it may not contain all the answers
- Keep to Maintenance Schedules

Important Safety Information

CAUTION

Read and understand this entire manual before repairing or adjusting this equipment. Consult Maintenance and Operation Manual for additional information.

Correct lockout and tagout procedures must be followed when servicing or repairing this equipment. Consult OSHA and ANSI guidelines. Technicians must be trained and familiar with the product.

Some of the troubleshooting tests described here require the hydraulic system to be active. In these instances, the truck should be placed in a safe location with the area cordoned off. Warn other personnel that the units is active and being worked on.

INFO

Many tests can be conducted with the engine shut off, but with the ignition switch left in the ON position.

2. Reference:

Operation and Maintenance Manual 105355
Schematics: AP8-E022; AP8-E023 Rev.3
Overview: AP8-E024 Rev.5

Tool requirements:
Multi meter with Hz % feature
Testing 'spoons' Leach Part # 723688 and 723705; Caterpillar Part # 7X-1708 and 7X-1709
(Leach Part # 972214 includes 723688 and 723705)
Deutsch pin puller Leach Part # 723937; Caterpillar part # 151-6320

Test site:
ECM plugs J1 and J2 (see page 33)

3. Entry/Exit Conditions

The first consideration in troubleshooting electronic system faults is to ensure that all Entry Conditions are met. If one of the Entry Conditions are not met or, if one of the Exit Conditions exist, the system will not function as intended.

Entry Condition: System is within electronic and operational parameters. Must meet all Entry Conditions simultaneously before entry

Note: all Entry Conditions expect ignition to be on, pump switch on

Exit Condition: System has experienced a condition that will limit operation. Any Exit Condition will force exit

The following pages detail each operational basic functionality in turn and contains tables of entry and exit conditions for each operation.

? **INFO** Prior to embarking upon in depth troubleshooting, technicians should verify that each of the entry conditions are met and none of the exit conditions exist

4. Pump Control

Basic Functionality

Activate pumps with pump switch on the Control Panel as long as the minimum safe conditions are met. Will switch pump off if a short to battery is detected on any hydraulic solenoid.

Notes: Joystick or switch states that are requesting hydraulic motion will not affect pump-on entry. The logic is that each individual circuit will have its own state machine forcing the operator to re-center the joystick/switch after pump on, before any commands will be allowed.
Pump switch must be cycled to recover from previous forced exit

ENTRY CONDITIONS	EXIT CONDITIONS
Pump switch ON	Pump switch OFF
Access ladder stowed	Access ladder down
No fault on pump solenoid	Fault detected on pump solenoid
No short-to-battery faults on any functions	Short-to-battery on any function
Engine RPM below 900	Engine RPM above 1900

5. Allison Transmission Program Parameters

The following parameters have been programmed into the transmission ECU at factory.

PARAMETER NAME	RPM
Maximum engine speed for PTO engagement	900
Maximum engine speed for PTO operation	1,900
Maximum output speed for PTO engagement	2,000
Maximum output speed for PTO operation	4,000
Maximum output speed for auto neutral	60
Speed to turn on output speed interlock	250-300 (7-10mph)
Speed to turn off output speed interlock	250-300 (7-10mph)

6. Hoist Control

Basic Functionality

Raise/lower body when proper conditions are met and operator is pressing the switch in the desired direction

Notes: Hoist raise/lower logic is identical to tailgate control logic
Switches must be re-centered if out of neutral at pump-on or after forced exit condition

ENTRY CONDITIONS	EXIT CONDITIONS
Pump switch ON	Pump switch OFF
Raise/Lower switch activated and held	Raise/Lower switch released
No fault hoist raise/lower solenoid (raise only)	Fault on hoist raise/lower solenoid (raise only)
No fault hoist lower solenoid (lower only)	Fault on hoist lower solenoid (lower only)
Arm home	Arm not home
Transmission in neutral	Transmission gear selected
Not in lift autocalibration mode	

7. Tailgate Open/Close Control

Basic Functionality

Open/close tailgate when proper conditions are met and operator is pressing the switch in the desired direction

Notes: Tailgate open/close logic is identical to hoist control logic
Switches must be re-centered if out of neutral at pump-on or after forced exit condition

ENTRY CONDITIONS	EXIT CONDITIONS
Pump switch ON	Pump switch OFF
Open/Close switch activated and held	Open/Close switch released
No fault tailgate open/close solenoid (open only)	Fault on tailgate open/close solenoid (open only)
No fault tailgate close solenoid (close only)	Fault on close solenoid (close only)
Arm home	Arm not home
Transmission in neutral	Transmission gear selected
Not in lift autocalibration mode	

8. Manual Pack/Return Control

Basic Functionality

Extend the pendulum when the proper conditions are met and the operator is holding down the pack button. Retract the pendulum when the proper conditions are met and the operator is holding down the return button.

Notes: Switch must be re-pressed after forced exit condition

ENTRY CONDITIONS	EXIT CONDITIONS
Pump switch ON	Pump switch OFF
No fault on any pack solenoid	Fault on any pack solenoid
Pack/return switch pressed and held	Pack/return switch released
No other control switch pressed	Any control switch pressed
Top doors open (if equipped)	Top doors closed (if equipped)
Tailgate closed and locked	Tailgate ajar and not fully open
Not in lift autocalibration mode	(Tailgate ajar and fully open OK for unload)

9. Autopack Control

Basic Functionality

In autopack mode, cycle the pendulum continuously

Notes: Illuminates Autopack lamp when cycle is active
Switch must be re-pressed after forced exit condition

ENTRY CONDITIONS	EXIT CONDITIONS
Pump switch ON	Pump switch OFF
No fault on any pack solenoid	Fault on any pack solenoid
Autopack switch pressed	Autopack stop switch pressed
No other control switch pressed	Any control switch pressed
Tailgate closed and locked	Tailgate ajar and not fully open
Top doors open (if equipped)	Top doors closed (if equipped)
Not in lift autocalibration mode	

10. Electronic Joystick Operational Requirements

- Joystick selector switch on Control Panel:
  must be set to 'ENABLE'

- Auto trigger on joystick:
  must be triggered prior to first operational input
  must be re-triggered to recover from a forced exit
  (for example: should the vehicle speed exceed 7mph 11kmph after loading, the joystick will need to be re-triggered)

11. Joystick - Manual Arm Control - Loading

Basic Functionality

- move arm functions when proper conditions are met
- the most functions state is "loading OK" where any motion within the operating zone is permitted provided that Entry Conditions are satisfied
- semi-functional state is manual return to home where only Lift Lower, Slide Retract, and Grab Open are allowed should any Exit Conditions exist
- fully locked out state permits no motion

Note: joystick out of center at neutral condition will never allow arm to enter loading state

ENTRY CONDITIONS	EXIT CONDITIONS
Pump switch ON	Pump switch OFF
Joystick centered, trigger toggled	Fault detected in joystick
Vehicle speed less than 7mph (11kmph)	Vehicle speed exceeds 7mph (11kmph)
Brake pedal depressed	Brake pedal not depressed
Tailgate not ajar or fully open	Tailgate ajar or fully open
No fault on any arm solenoid or lift position sensor	Fault detected on any arm solenoid
Top door(s) open (if equipped)	Top door(s) close (if equipped)
All return to home conditions OK	

12. Joystick - Manual Arm Control - Return to Home

Basic Functionality

- move arm functions when proper conditions are met
- the most functions state is “loading OK” where any motion within the operating zone is permitted provided that Entry Conditions are satisfied
- semi-functional state is manual return to home where only Lift Lower, Slide Retract, and Grab Open are allowed should any Exit Conditions exist
- fully locked out state permits no motion

ENTRY CONDITIONS	EXIT CONDITIONS
Pump switch ON	Pump switch OFF
No fault in lift lower, slide retract, grab open solenoids	Fault on return to home solenoid
No fault on any joystick axis	Fault on joystick axis
Not in lift autocalibration mode	

13. Joystick - Automatic Dump Arm Control

Basic Functionality

- provide automated arm control when proper conditions are met
- automatically dump can previously gripped by operator and return can to the point at which autodump was initially triggered
- once successfully engaged, autodump will:
  - apply a small grip command and lift to the top of the load zone
  - retract slide fully
  - raise to dump can; briefly shake can
  - wait for a toggle of the autodump switch state (operator input)
  - lower to the top of the load zone
  - slide out to original slide extension (where autodump was initiated)
  - lower can to the original lift position (where autodump was initiated)
  - operator input required to release can (manually or using return to home function)

Note: joystick out of center at neutral condition will never allow arm to enter loading state
Autodump parameter must be enabled
Timeout of any part of the autodump operation (default times set approx. 3 times normal operating time for respective condition)

ENTRY CONDITIONS	EXIT CONDITIONS
Pump switch ON	Pump switch OFF
Joystick centered, trigger toggled	Fault detected in joystick
Vehicle speed less than 7mph (11kmph)	Vehicle speed exceeds 7mph (11kmph)
Brake pedal depressed	Brake pedal not depressed
Autodump button pressed and held	Autodump button released
Lift below the load zone height	Lift above the load zone height
Grip not fully open	Grip fully open
Body not raised, tailgate not ajar	Body raised, tailgate ajar
No fault on any arm solenoid or lift position sensor	Fault detected on any arm solenoid
Tailgate not ajar or fully open	Tailgate ajar or fully open
Top door(s) open (if equipped)	Top door(s) close (if equipped)
	Any large joystick motion (>50%)

14. Joystick - Automatic Return to Home (RTH) Arm Control

Basic Functionality

- provide automated arm control to return arm fully home (lift fully lowered, slide fully retracted, grip open) when proper conditions are met
- triggered by top joystick thumb button, dead-man control (must be held)
- will continue to try to retract arm as long as button is held (no logic to turn off commands when arm is home)
- once engaged, RTH will retract grip cylinder, slide cylinder, arm lift cylinder in turn

Note: can still activate Return to Home if main joystick is disabled
vehicle speeds in excess of 7mph 11kmph does NOT lockout Return to Home
RTH parameter must be enabled

ENTRY CONDITIONS	EXIT CONDITIONS
Pump switch ON	Pump switch OFF
Autostow button pressed and held	Autostow button released
Lift below the load zone height	Lift above the load zone height
No fault on any joystick axis	No fault on any joystick axis
No fault on any arm solenoid	Fault detected on any arm solenoid
No fault on lift position sensor	Fault on lift position sensor
Body not raised, tailgate not ajar	Body raised, tailgate ajar

15. Indicator/Non-Hydraulic Output Control

Basic Functionality

- **Arm not home indicator:** illuminates control panel warning lamp if grip not fully open, slide not fully retracted, lift position not fully down or when lift position sensor fault present

- **Arm not home and speed exceeds 7mph (11kmph):** illuminates control panel warning lamp and sounds alarm if grip not fully open, slide not fully retracted, lift position not fully down or when lift position sensor fault present AND speed exceeds 7mph (11kmph)

- **System warning light blinks warning codes when present:** see Flash Code Values Table

- **Tailgate ajar indicator:** illuminates control panel warning lamp, sounds in-cab alarm and back-up alarm when tailgate unlocked

- **Body raised indicator:** illuminates control panel warning lamp, sounds in-cab alarm when body is raised

- **Autopack indicator:** illuminates Autopack switch warning lamp when Autopack active

- **Access ladder down:** illuminates control panel warning lamp, sounds in-cab alarm when access ladder is down. Will cause exit condition for pump control

- **Packer blade stall warning lamp:** illuminates control panel warning lamp whenever pendulum stalls against refuse, activating the pack pressure switch

- **Bin counter:** advances the counter 0.6 seconds after arm leaves the load zone

- **Hydraulic oil cooler relay:** turn on relay when oil temperature switch is active

16. Arm Lift Calibration Routine

This routine is provided to automatically calibrate the initiation currents for the lift raise and lift lower functions. It uses cylinder position information to determine the current level at which motion in either direction begins. It is intended for periodic use by trained maintenance technicians only in order to reset the pre-programmed operating cushions at the top and bottom ends of lift motion. It is designed to be initiated through a sequence of button presses.

The calibration routine should be used when the machine has reached normal operating temperature (90*C). After the routine has executed, the calibration values will automatically be updated and the arm will be ready to use for normal operation. All other hydraulic circuits will be locked out during calibration.

INFO

If the ECM is ever washed after a calibration routine has been performed, the calibration values will revert to their default values and the calibration routine will have to be re-run.
If the lift arm position sensing cylinder is replaced, it is advisable to run a calibration routine as this will calibrate the new cylinder.

CAUTION

The routine will move the lift cylinder without warning.
Be sure to leave enough space for the arm to operate and cordon off the area to avoid inadvertent contact.
Warn other shop personnel that the calibration is being conducted.
Turning off the pump switch or un-centering the joystick at any time will stop the routine.

Minimum Operating Conditions (must be met during entire calibration sequence)
Pump ON
Joystick centered
Transmission in neutral

Start Condition (must be met before and during button press)
Arm home

Calibration Sequence

1. Simultaneously press and hold **manual pack**, **manual return** and **autopack** buttons for more than 3 seconds
2. While maintaining hold on the **autopack** button, release **manual pack** and **manual return** buttons
3. Maintain **autopack** button depressed for additional 3+ seconds after releasing other buttons. Once the auto-calibration routine has started, **autopack** button can be released
4. Lift cylinder motion indicates calibration routine has successfully started
5. Arm will rise to a center position, rise slightly further, lower slightly, rise slightly, lower slightly, and then it will travel a full stroke
6. The arm will travel up and down 5 times. After this has been completed, and the arm is at the home position, turn the ignition key off
7. After 10 seconds, turn the ignition key back on and start the vehicle. This ensures that the calibration is complete.

?
INFO

Use the **pump OFF switch** or **un-center the joystick** as an emergency stop to end the auto-calibration early if necessary

During the entire calibration sequence, the system warning alarm will sound

No calibration values will be updated unless the entire calibration completes successfully

17. Diagnostic Flash Code Values

The Caterpillar electronic control module monitors certain components in the system for faults. The valve solenoids, joystick and position sensing cylinder are all monitored by the controller. If the control module detects a fault in these systems, it will initiate a series of warning flashes in sequence to aid in diagnosing the fault quickly. The red system warning light mounted into the control panel will flash in a series of three numerical sets. Once this sequence of flashes is complete, the warning light will extinguish briefly and then the sequence begins again. The technician must count this sequence of flashes and refer to the chart below to determine the faulty circuit/component.

For example: the system warning light flashes 6 times, pauses, flashes 3 times, pauses, flashes 2 times, pauses for longer, then repeats;
this sequence is **6.3.2** indicating a problem with **Lift arm grabber open solenoid.**

? **INFO** Upon ignition start up, the system warning completes a self test by issuing a 6.5.4 sequence. This is normal

Outputs

FAULT DESCRIPTION	FLASH CODE
Lift arm raise solenoid	6.3.4
Lift arm lower solenoid	6.3.5
Lift arm slide extend solenoid	6.3.6
Lift arm slide retract solenoid	6.3.7
Lift arm grabber close solenoid	6.3.3
Lift arm grabber open solenoid	6.3.2
Pendulum extend solenoid	6.3.8
Pendulum retract solenoid	6.3.9
Tailgate raise solenoid	6.4.2
Tailgate lower solenoid	6.4.1

Outputs (cont)

FAULT DESCRIPTION	FLASH CODE
Body raise solenoid	6.4.5
Body lower solenoid	6.4.6
Bin counter	6.4.7
Pump on output (to coil)	6.4.9

Inputs

FAULT DESCRIPTION	FLASH CODE
Lift arm cylinder position sensor	6.1.1
Joystick X-Axis (slide)	6.5.4
Joystick Y-Axis (lift)	6.5.5
Joystick thumbwheel (grabber)	6.5.6

Miscellaneous System Issues

FAULT DESCRIPTION	FLASH CODE
Harness code invalid	4.1.2
System voltage	5.1.1
8v sensor supply	5.1.7
5v sensor supply	5.1.6

The flash codes will alert the technician to a failure in the circuit indicated. The cause may be a failed component such as a joystick or position sensing cylinder, or as simple as a loose connector or broken wire. Flash codes mean that an exit condition exists and the related function will not operate.

The cause of the flash code should be investigated first by a visual check of the components related to that function.

18. Visual Diagnostic Display - Messenger

Included with the Caterpillar loading control system is a diagnostic LCD display unit that has the ability to monitor the vehicle and engine information (certain chassis wiring interface connections are required for these features). Potentially serious engine problems are displayed automatically and engine diagnostic codes may be accessed by the driver.

When connected, data links are used to provide performance and operating information to Messenger. The system has the capability to display and record fuel usage, average miles per gallon, oil pressure, coolant temperature and more on an LCD display. Drivers can also monitor their performance in achieving fuel economy goals.

CAUTION

Do not attempt to manipulate the display while the vehicle is moving. This could divert attention from driving and result in personal injury or equipment damage

INFO

Further information is available from your Caterpillar dealer by requesting manual REHS1413

The Messenger system displays diagnostic codes for the body systems monitored by the ECM. Faults displayed as a series of flashes on the Control Panel System Warning light are also displayed on the LCD display.
The fault is displayed on the screen as a '*Diagnostic Event*', along with a brief description such, as *'Body Lift Sol Open'*

Users have the ability to adjust select arm operational settings through the Messenger. In order to do this, the Service Mode must be enabled.
Using the simple navigation keys, toggle through the Main Menu until '*Service Mode'* is displayed.

Select *'Service Mode ENABLED'* and use the *'back'* key to return to the Main Menu

? **INFO**

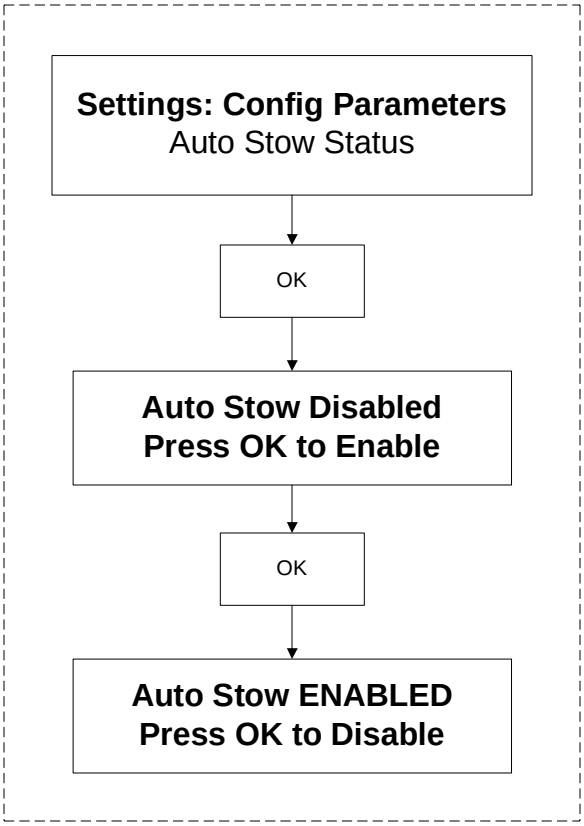
The default setting for Service Mode is DISABLED. It will revert to disabled when the ignition key is switched off

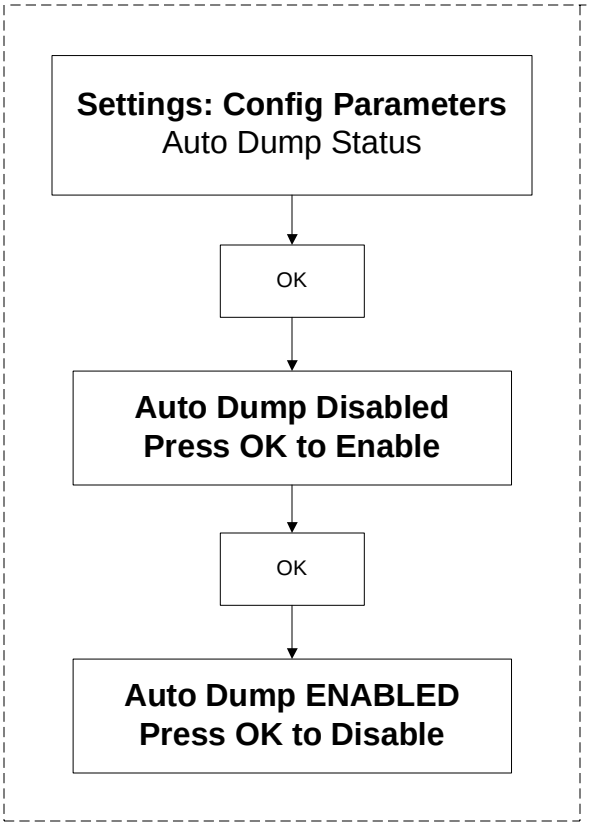
Use the up/down toggles to select *'Settings'*
Press *'OK'*

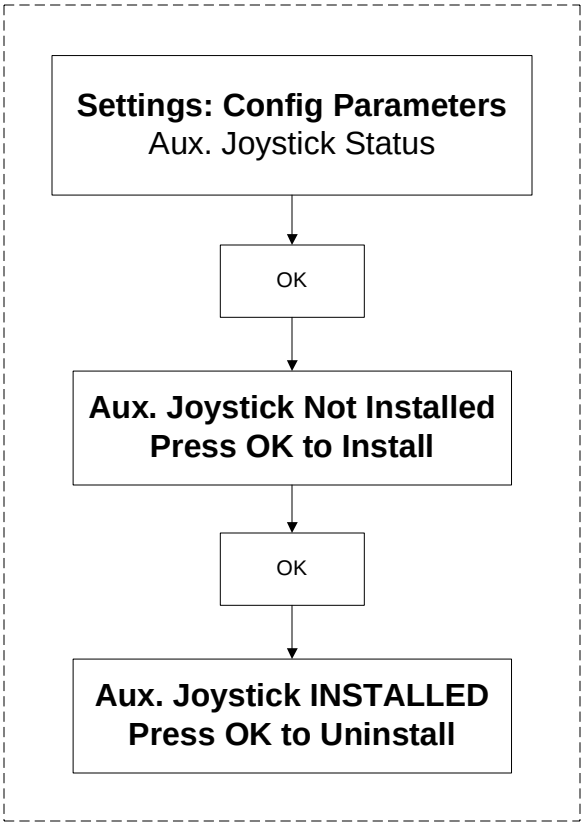
Use the up/down toggles to select *'Config Parameters'*
Press *'OK'*

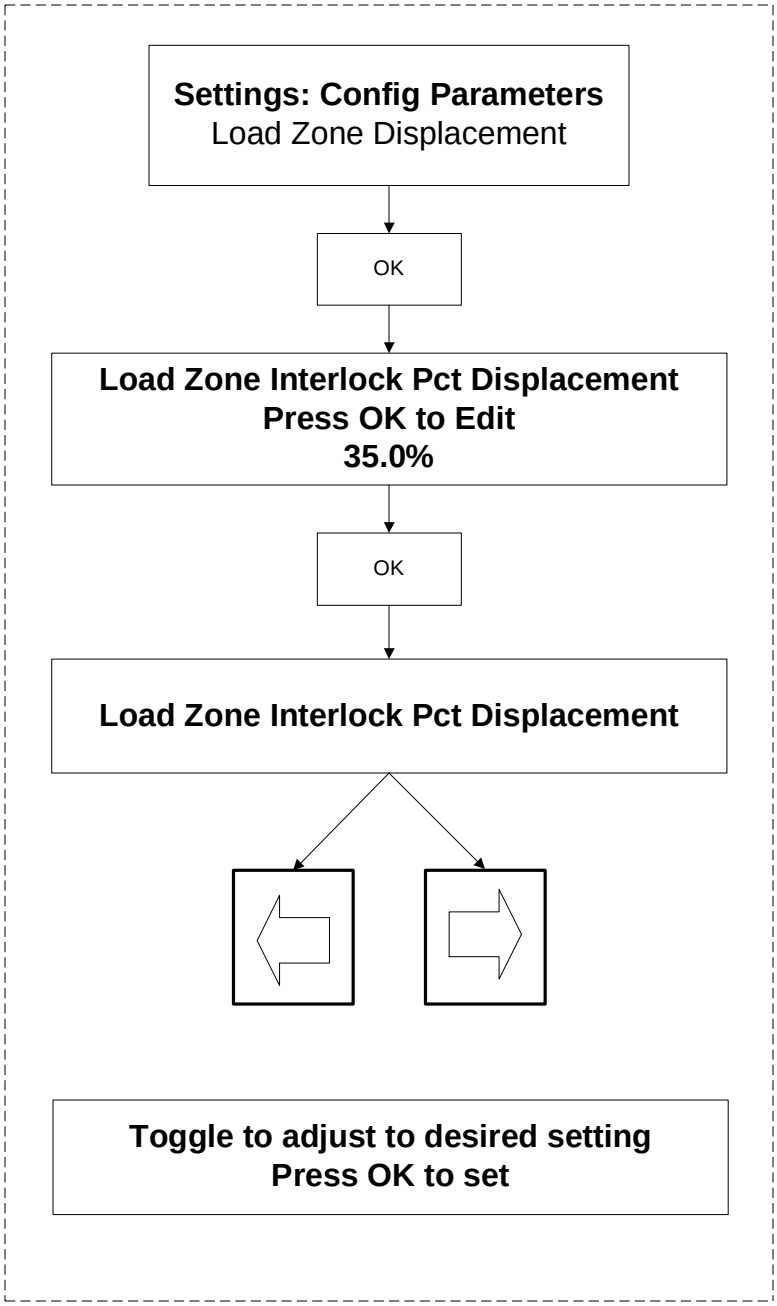
Within the CONFIG PARAMETERS menu select arm operational settings can be adjusted as follows:

- AUTO STOW - enables or disables the arms' ability to Return to Home with a single joystick button press
- AUTO DUMP - enables or disables the arms' ability to dump a container with a single joystick button press
- AUX JOYSTICK STATUS - if equipped, enables or disables the secondary joystick
- LOAD ZONE DISPLACEMENT - gives the operator the ability to adjust the maximum height to which the arm raises while the slide is extended


Settings: Config Parameters
Auto Stow Status
OK
Auto Stow Disabled
Press OK to Enable
OK
Auto Stow ENABLED
Press OK to Disable


Settings: Config Parameters
Auto Dump Status
OK
Auto Dump Disabled
Press OK to Enable
OK
Auto Dump ENABLED
Press OK to Disable


Settings: Config Parameters
Aux. Joystick Status
OK
Aux. Joystick Not Installed
Press OK to Install
OK
Aux. Joystick INSTALLED
Press OK to Uninstall



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INFO

The lower the percentage value set for Load Zone Interlock, the lower the height interlock engages when the slide is deployed

19. Switch Input Verification

Switch Input Verification aims to pinpoint faults by identifying individual wires at the Electronic Control Module, and testing through the connector to verify voltage readings.

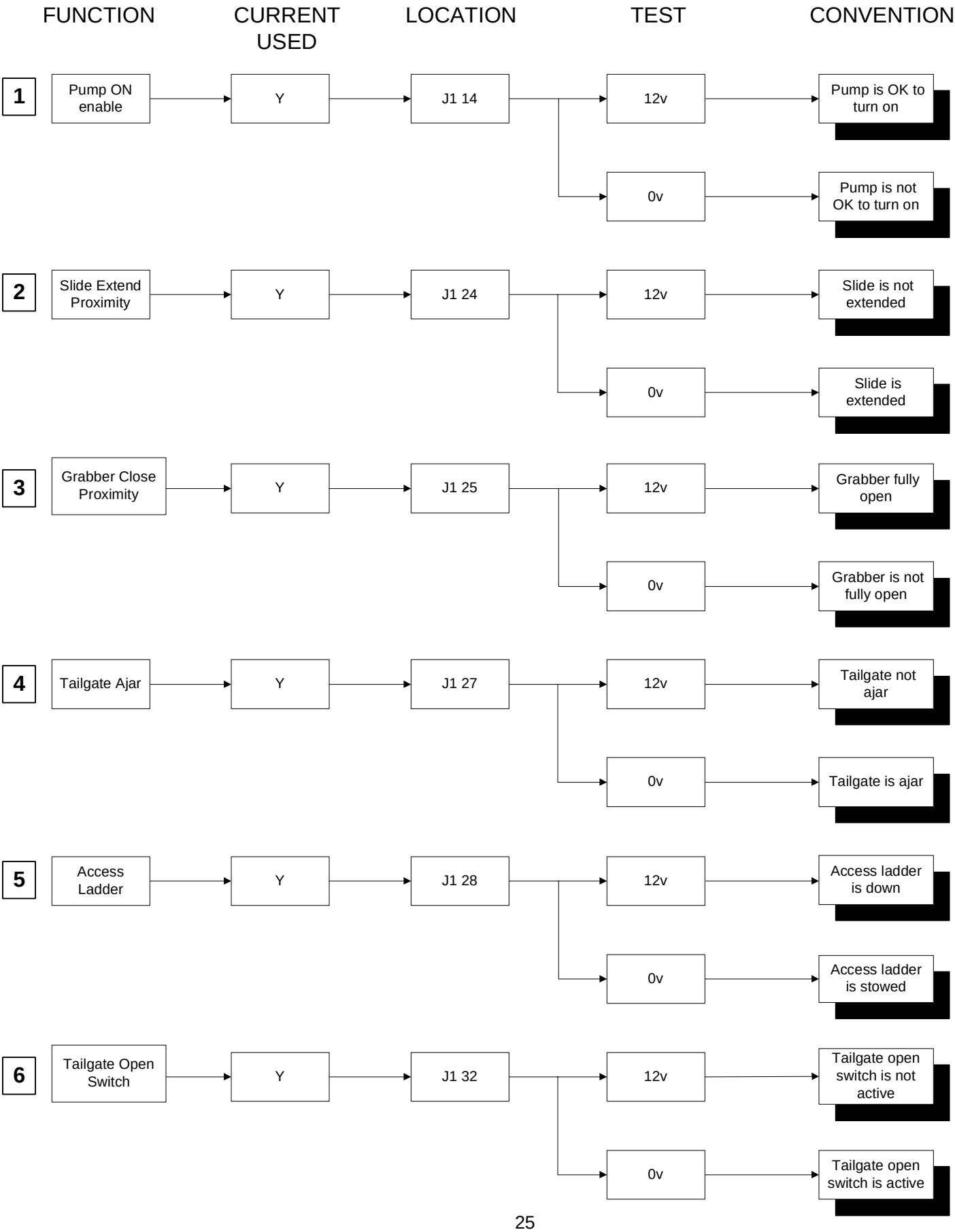
Using an Ohm meter set to the VOLT function, technicians may test the relevant pins to determine if voltages are correct at the ECM. Most circuits are tested for a 0v condition or a 12v condition; the joystick circuits are tested for Hz% duty cycle and voltage.

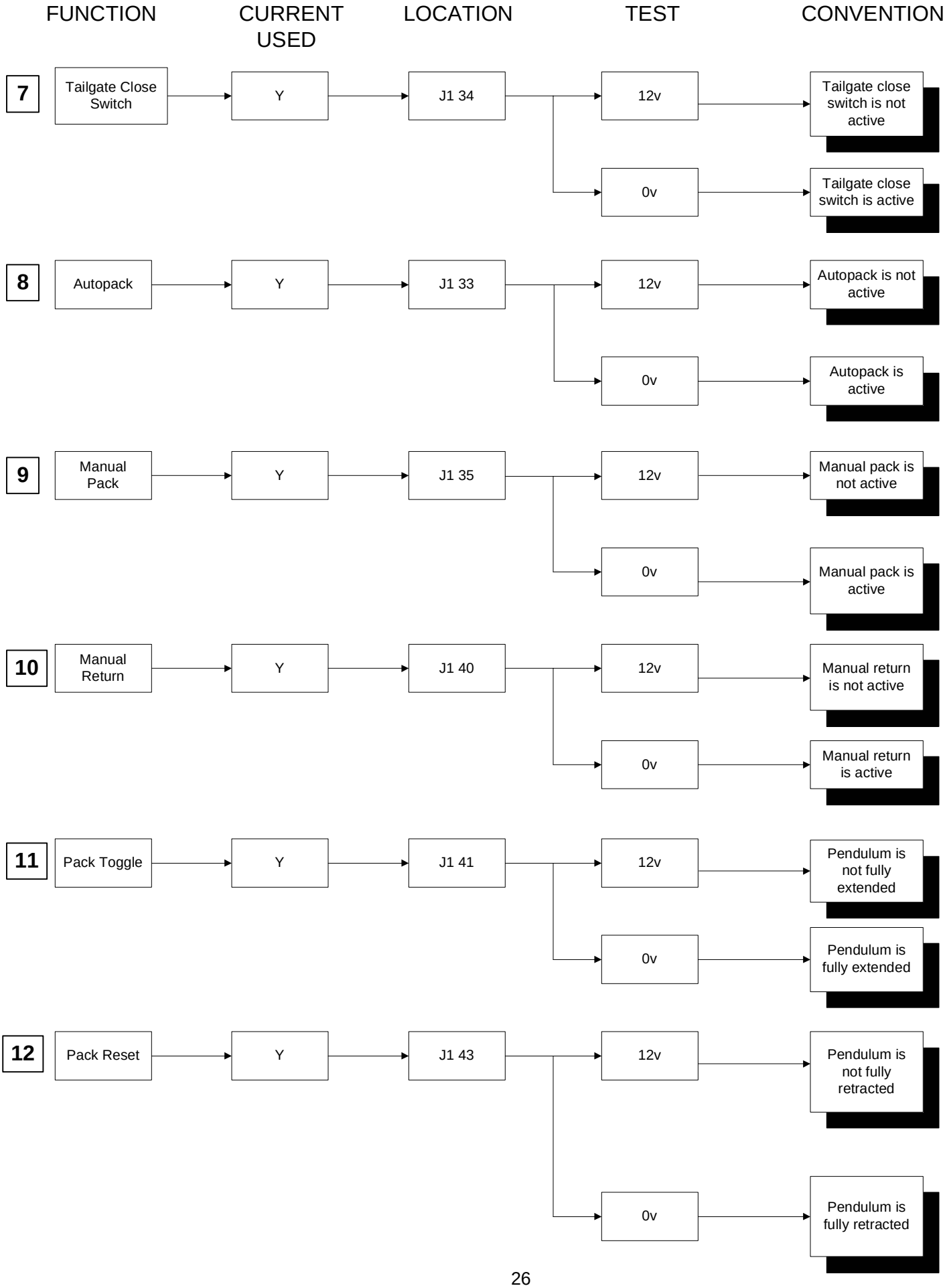
The pin to pin identification charts allow the technician to make continuity checks of the harnesses between the ECM and the relevant in cab control or valve solenoid etc.

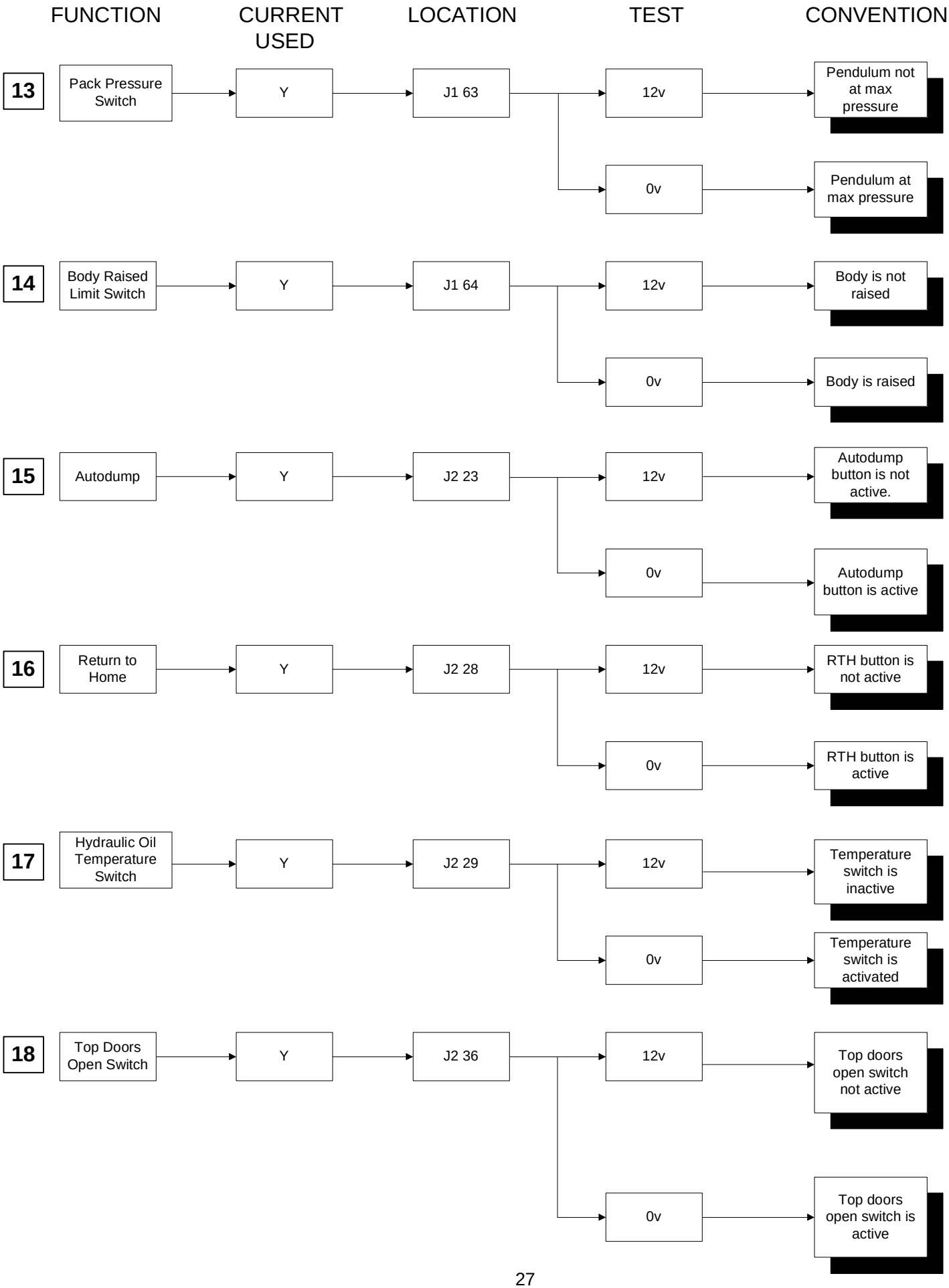
Use the following charts for reference.

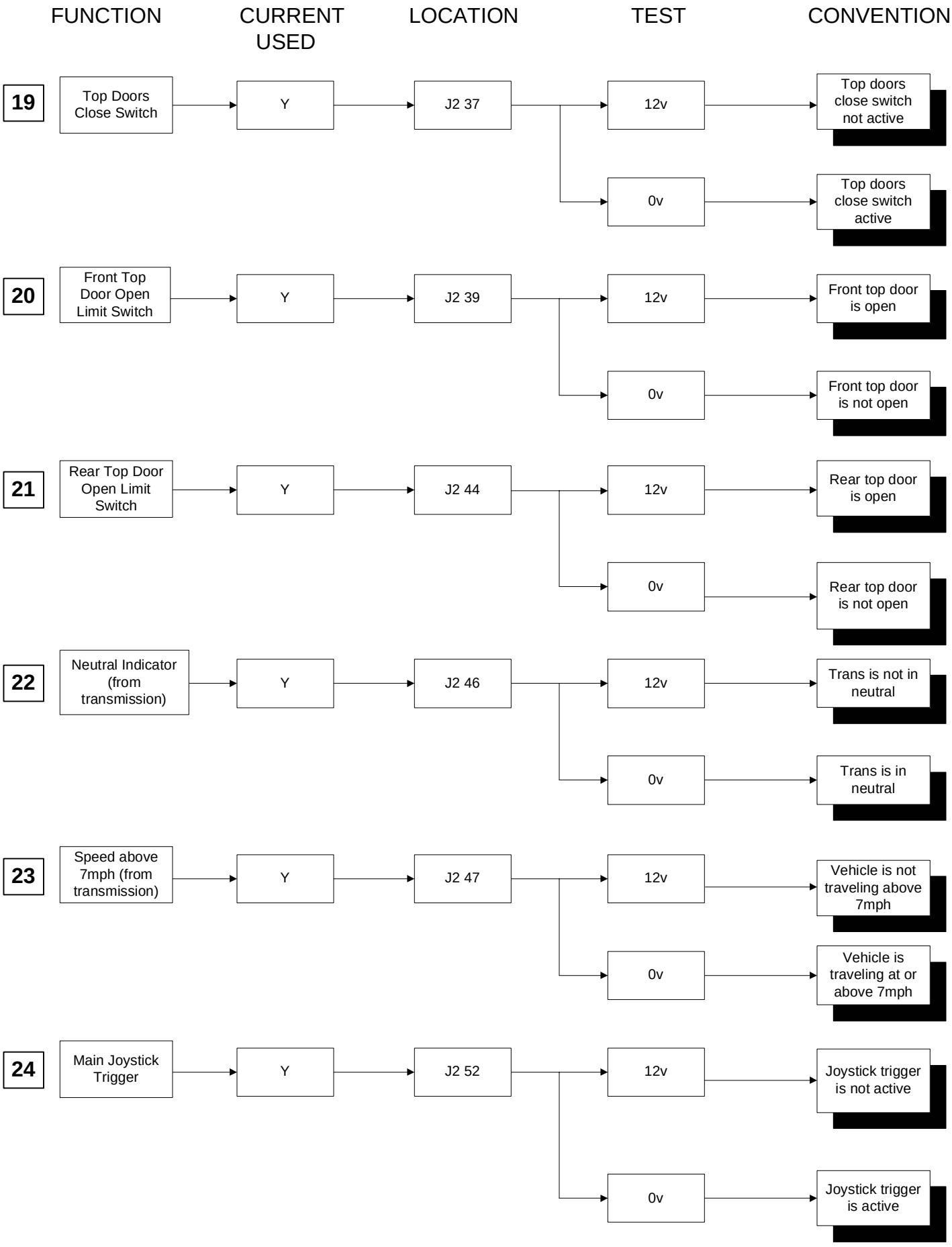
1. Pump on enable
2. Slide extend proximity switch
3. Grabber close proximity switch
4. Tailgate ajar
5. Access ladder down
6. Tailgate open switch
7. Tailgate close switch
8. Autopack
9. Manual pack
10. Manual return
11. Pack toggle
12. Pack reset
13. Pack pressure switch
14. Body raised limit switch
15. Autodump
16. Return to home
17. Hydraulic oil temperature switch
18. Top doors open switch
19. Top doors close switch
20. Front top door open limit switch
21. Rear top door open limit switch
22. Neutral indicator
23. Speed above 7mph (11kmph)
24. Main joystick trigger
25. Aux joystick trigger
26. Body raise switch
27. Body lower switch
28. Indicator non hydraulic voltage chart
29. Solenoid voltage/resistance chart
30. Digital Joystick Input Verification

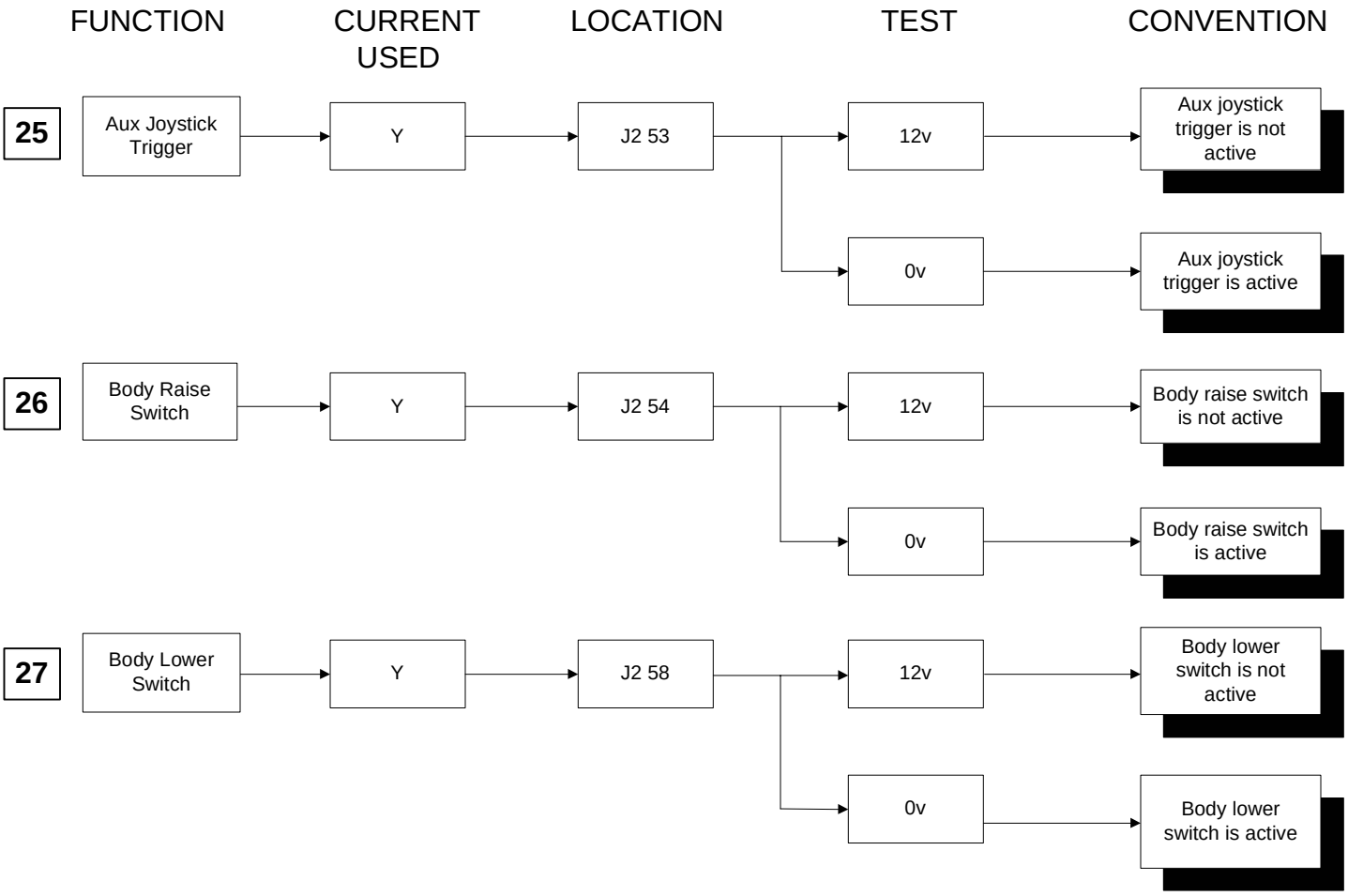
Switch Input Verification




FUNCTION
CURRENT USED
LOCATION
TEST
CONVENTION
7
Tailgate Close Switch
Y
J1 34
12v
Tailgate close switch is not active
0v
Tailgate close switch is active
8
Autopack
Y
J1 33
12v
Autopack is not active
0v
Autopack is active
9
Manual Pack
Y
J1 35
12v
Manual pack is not active
0v
Manual pack is active
10
Manual Return
Y
J1 40
12v
Manual return is not active
0v
Manual return is active
11
Pack Toggle
Y
J1 41
12v
Pendulum is not fully extended
0v
Pendulum is fully extended
12
Pack Reset
Y
J1 43
12v
Pendulum is not fully retracted
0v
Pendulum is fully retracted


FUNCTION
CURRENT USED
LOCATION
TEST
CONVENTION
13
Pack Pressure Switch
Y
J1 63
12v
Pendulum not at max pressure
0v
Pendulum at max pressure
14
Body Raised Limit Switch
Y
J1 64
12v
Body is not raised
0v
Body is raised
15
Autodump
Y
J2 23
12v
Autodump button is not active.
0v
Autodump button is active
16
Return to Home
Y
J2 28
12v
RTH button is not active
0v
RTH button is active
17
Hydraulic Oil Temperature Switch
Y
J2 29
12v
Temperature switch is inactive
0v
Temperature switch is activated
18
Top Doors Open Switch
Y
J2 36
12v
Top doors open switch not active
0v
Top doors open switch is active


FUNCTION
CURRENT USED
LOCATION
TEST
CONVENTION
19
Top Doors Close Switch
Y
J2 37
12v
Top doors close switch not active
0v
Top doors close switch active
20
Front Top Door Open Limit Switch
Y
J2 39
12v
Front top door is open
0v
Front top door is not open
21
Rear Top Door Open Limit Switch
Y
J2 44
12v
Rear top door is open
0v
Rear top door is not open
22
Neutral Indicator (from transmission)
Y
J2 46
12v
Trans is not in neutral
0v
Trans is in neutral
23
Speed above 7mph (from transmission)
Y
J2 47
12v
Vehicle is not traveling above 7mph
0v
Vehicle is traveling at or above 7mph
24
Main Joystick Trigger
Y
J2 52
12v
Joystick trigger is not active
0v
Joystick trigger is active


FUNCTION
CURRENT USED
LOCATION
TEST
CONVENTION
25
Aux Joystick Trigger
Y
J2 53
12v
Aux joystick trigger is not active
0v
Aux joystick trigger is active
26
Body Raise Switch
Y
J2 54
12v
Body raise switch is not active
0v
Body raise switch is active
27
Body Lower Switch
Y
J2 58
12v
Body lower switch is not active
0v
Body lower switch is active

28 Indicator non hydraulic voltage chart

DESCRIPTION	PIN #	ACTIVE VOLTAGE	INACTIVE VOLTAGE	NORMAL COIL RESISTANCE
Arm not home indicator lamp	J2 09	0v	12v	N/A
Arm not home and >7mph	J2 10	0v	12v	N/A
System warning indicator	J2 11	0v	12v	N/A
Pendulum stall indicator	J2 12	0v	12v	N/A
Body up indicator	J2 13	0v	12v	N/A
Tailgate ajar indicator	J2 19	0v	12v	N/A
Autopack lamp indicator	J2 20	0v	12v	N/A
Access ladder indicator	J2 21	0v	12v	N/A
Bin counter	J2 03	12v	0v	N/A
Pump on output (to coil)	J2 05	0v	12v	N/A
Hydraulic oil cooler relay	J2 06	0v	12v	N/A

29 Solenoid voltage/resistance chart

DESCRIPTION	PIN #	ACTIVE VOLTAGE	INACTIVE VOLTAGE	NORMAL COIL RESISTANCE
Top doors open solenoid	J2 07	12v	0v	
Top doors close solenoid	J2 112	12v	0v	
Lift arm raise solenoid	J1 48		0v	5.3Ohms
Lift arm lower solenoid	J1 49		0v	5.3Ohms
Slide extend solenoid	J1 51		0v	5.3Ohms
Slide retract solenoid	J1 52		0v	5.3Ohms
Grabber close solenoid	J1 58		0v	5.3Ohms
Grabber open solenoid	J1 59		0v	5.3Ohms
Pendulum extend solenoid	J1 61		0v	5.3Ohms
Pendulum retract solenoid	J1 62		0v	5.3Ohms
Tailgate raise solenoid	J1 65		0v	5.3Ohms
Tailgate lower solenoid	J1 66		0v	5.3Ohms
Body raise solenoid	J1 667		0v	5.3Ohms
Body lower solenoid	J1 68		0v	5.3Ohms

30 Electronic Joystick Input Verification

The electronic joystick operates using Pulse Width Modulation (PWM) outputs for the slide, arm and grab functions, as well as fixed output voltage for the push button functions auto-dump, auto-stow.
PWM is an output signal characterized by a change in the duty cycle of a square wave. This is measured as a Hz% on the multi-meter. When the joystick is inactive (neutral position) the multi-meter Hz% is approx. 50%. The range of acceptable values is between 5%-95% when the joystick slide, lift or grab functions are operated to their maximum position.

The electronic joystick can be tested for failure condition using a multi-meter to record readings at the relevant pin connections. Readings outside the parameters detailed here may indicate a failure in the joystick.

? **INFO** The electronic joystick sensor is designed so that it does not fail with an acceptable output

The main cab connector is a convenient location for conducting the joystick verification tests. The technician is able to operate the joystick and observe the meter readings at the same time and remain clear of the arm assembly.
Remove the covers to expose the 70 pin connector in the cab footwell.
Refer to overview drawing AP8-E024 rev 5 for connector and pin locations.

i The first test is to ensure the joystick is receiving a power supply

WIRE #	PIN CONNECTOR #	METER READING
J144 Power Insert Pos + spoon	10	8v
J145 Ground Insert Neg - spoon	11	

ii Neutral joystick position @ 50%+-

Note: any one of the following functions will show a 50% duty cycle when the joystick is in neutral:
Slide extend/retract wire 224
Arm raise/lower wire 225
Grabber open/close wire 226
Insert only the Pos+ meter wire into the connector - there is no requirement for the meter to be grounded for %duty cycle tests

WIRE #	PIN CONNECTOR #	METER READING
J224 Slide Extend Retract J225 Arm Raise/Lower J226 Grabber Open/Close	45 46 47	50%+-

iii Joystick Slide/Extend duty cycle

Note: Insert only the Pos+ meter wire into the connector - there is no requirement for the meter to be grounded for %duty cycle tests
The maximum range of acceptable values is 5%-95%

WIRE #	PIN CONNECTOR #	JOYSTICK OPERATION	METER READING
J224 Slide Extend Retract	45	Slide Extend	20%+-
J224 Slide Extend Retract	45	Slide Retract	80%+-

iv Joystick Arm Raise/Lower duty cycle

Note: Insert only the Pos+ meter wire into the connector - there is no requirement for the meter to be grounded for %duty cycle tests
The maximum range of acceptable values is 5%-95%

WIRE #	PIN CONNECTOR #	JOYSTICK OPERATION	METER READING
J225 Arm Raise Lower	46	Arm Raise	20%+-
J225 Arm Raise Lower	46	Arm Lower	80%+-

v Joystick (thumbwheel) Grabber Open/Close duty cycle

Note: Insert only the Pos+ meter wire into the connector - there is no requirement for the meter to be grounded for %duty cycle tests
The maximum range of acceptable values is 5%-95%

WIRE #	PIN CONNECTOR #	JOYSTICK OPERATION	METER READING
J226 Grabber Open Close	47	Grabber Close	20%+-
J226 Grabber Open Close	47	Grabber Open	80%+-

vi Joystick Auto Dump (single button push)
Joystick Auto Stow (single button push)
Joystick Trigger (single toggle)

Note: Insert the Pos+ meter wire into the connector pin
Insert black cable into connector pin # 11 ground wire #145

WIRE #	PIN CONNECTOR #	JOYSTICK OPERATION	METER READING
J223 Arm Auto Dump	22	Auto Dump button NOT pressed	12.9V
J223 Arm Auto Dump	22	Auto Dump button pressed	0v
J228 Arm Auto Stow	49	Auto Stow button NOT pressed	12.9V
J228 Arm Auto Stow	49	Auto Stow button pressed	0v
J252 Main Joystick Trigger	63	Trigger NOT pressed	12.9V
J252 Main Joystick Trigger	63	Trigger pressed	0v

20. Connectors

The Caterpillar control system uses sealed Deutsch connectors to connect wiring harnesses to major control components. It is critical to maintain integrity of connectors, pins, seals and wires to ensure the system continues to function correctly. Special tools are required to service Deutsch connectors.

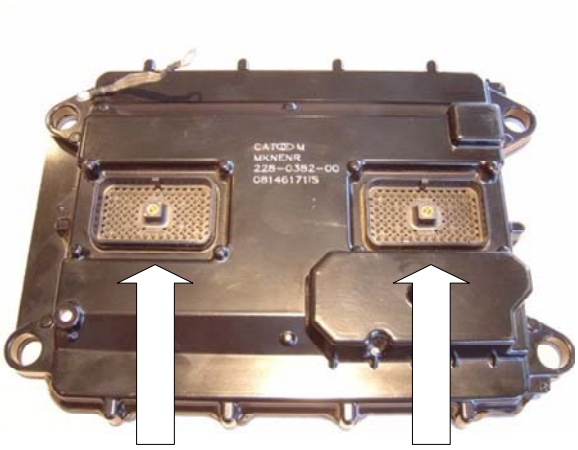
?

INFO

The Caterpillar Position Sensing Cylinder (PSC) uses a pulse modulation system that requires gold contacts to be used in the cylinder communication connectors. If a cable requires replacement in the field, gold contacts will have to be used.

Common symptoms are erratic or total loss of the cylinder operation. Normal resistance or continuity checks will show the harness in good condition and directs the solution to be the replacement of the cylinder.

Caterpillar Electronic Control Module



J2 **J1**

The Caterpillar system is controlled through the ECM mounted underneath the main valve.

Two harnesses connect to the ECM via Deutsch connectors into the ECM multi-pin plugs.

Each connector is keyed differently and cannot be misassembled. Uses a standard 4mm allen bolt and the seal is provided by a blue rubber gasket in the harness plug.

The harness plugs are identified as J1 and J2. The plug closest to the prominent bulge in the ECM is J1

?

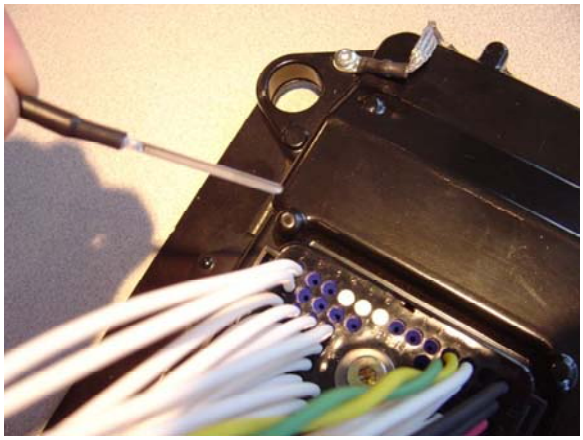
INFO

It is not necessary to disconnect plugs in order to conduct system troubleshooting via Input Verification tests. Unnecessary disruption of plugs may lead to damage of pins and seals.

To gain easier access to the plugs, dismount the ECM and suspend it from the valve table using tie-wraps. (Ensure the ground strap remains connected)

Connectors

The ECM plugs secure the harness connectors to the ECM pins. Not all of the available spaces are used. Unused spaces must be fitted with sealing plugs.
Refer to Pin out charts page 39-40 for correct pin placement.
Switch input verification test locations refer to this numbered location in the plug to take the readings



During switch input verification tests, special ‘spoons’ are required to contact the pin inside the sealed plug in order to take readings. The wire from the spoon is connected to the test meter.

?

INFO

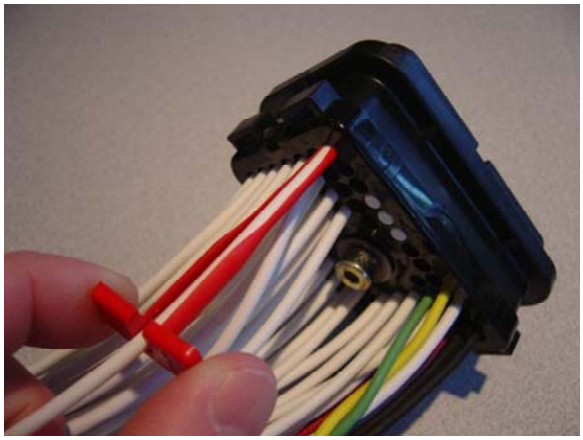
It is critical to maintain effective sealing at this plug.

Ingress of contamination will seriously damage the ECM

No other tools are to be used in this application

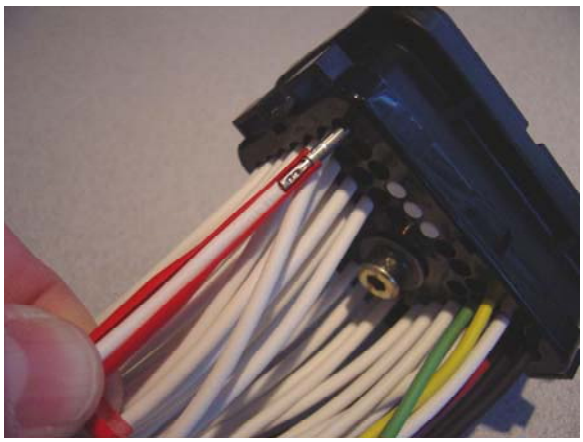
Connectors

If the need arises, wires may be pulled from the Deutsch connector using a special pin puller shown at left



Clip the pin puller onto the wire casing and gently insert the pin puller into the connector.

Feel the wire release as the terminal is unlocked from the connector



Pull the wire out of the connector, followed by the pin puller.

To replace the wire, simply reinsert the terminal into the connector and push in until a click is felt as the terminal is retained by the connector

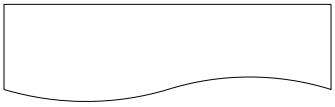
1	Key-On	Unused	Unused	Unused	Unused	Unused	Unused	CDL +	Unused	Top Doors Close Solenoid	Batt - 1	13
14	Pump On Enable (from	Unused	Unused	Unused	Unused	Unused	Unused	CDL -	Unused	Unused	Batt - 2	23
24	Slide Exended Proxy	Grabber Close Proxy	Unused	Tailgate Ajar	Unused	Unused	Unused	Access Ladder Down	Unused	Unused	Batt + 1	31
32	Tailgate Open (Cab)	Autopack	Tailgate Close (Cab)	Manual Pack	J1			Unused	Unused	Unused	Batt + 2	39
40	Manual Return	Pack Toggle	Unused	Pack Reset				8V Sensor Power	8V Sensor Return	Batt + 5	Batt + 3	47
48	Lift Arm Raise Solenoid	Lift Arm Lower Solenoid	Lift, Slide Returns	Slide Extend	Slide Retract			Unused	Unused	Tailgate, Hoist Returns	Batt - 3	57
58	Grabber Close Solenoid	Grabber Open Solenoid	Grabber, Packer Blade	Packer Blade Extend	Packer Blade Retract	Packing Pressure Switch	Body Raised Limit Sw	Tailgate Lower Solenoid	Body Raise (Hoist Up)	Body Lower (Hoist	Unused	70

1	+Batt	Bin Counter	Unused	Load Ret 1	Pump On Output	Hydraulic Oil Cooler Relay	Top Doors Open Solenoid	Load Ret 2	Arm Not Home (Lamp)	Arm not home & travelling	System Warning Indicator	Packer Blade Stall	Body Up Indicator	13
14	Unused	Lift Arm Cylinder Posn.	Unused	Unused	Unused				Tailgate Ajar Indicator	Autopack Indicator	Access Ladder Indicator	Unused	Autodump	23
24	Main Joystick X-Axis	Main Joystick Y-Axis	Main Joystick Thumbwh	Unused						Return to Home	High Hydraulic Oil Temp	Joystick Selector Posn. 1	Joystick Selector Posn. 2	31
32	Unused	Unused	Unused	Unused			J2			Top Doors Open (Cab)	Top Doors Close (Cab)	Service Stand Stowed	Front Top Door Open	39
40	Unused	Unused	Unused	Unused						Rear Top Door Open	Unused	Neutral Indicator	Travelling above 7mph	47
48	Unused	Unused	Unused	Unused	Main Joystick Trigger				Aux Joystick Trigger	Body Raise Switch	Unused	Unused	Unused	57
58	Body Lower Switch	Harness Code Loc. 0	Harness Code Loc. 1	Harness Code Loc. 2	Harness Code Loc. 3	Unused	J1939 +	J1939-	J1939 Shield	Unused	Unused	Unused	Unused	70

21. Troubleshooting Charts

The following pages detail the steps necessary to investigate common faults with the Caterpillar electronic control system.

Indicates a step to be taken



Contains notes and reminders

Conclusion

?

INFO

Technical support and further troubleshooting advice is available by calling the FSDepot call center toll-free (877) 800.1111

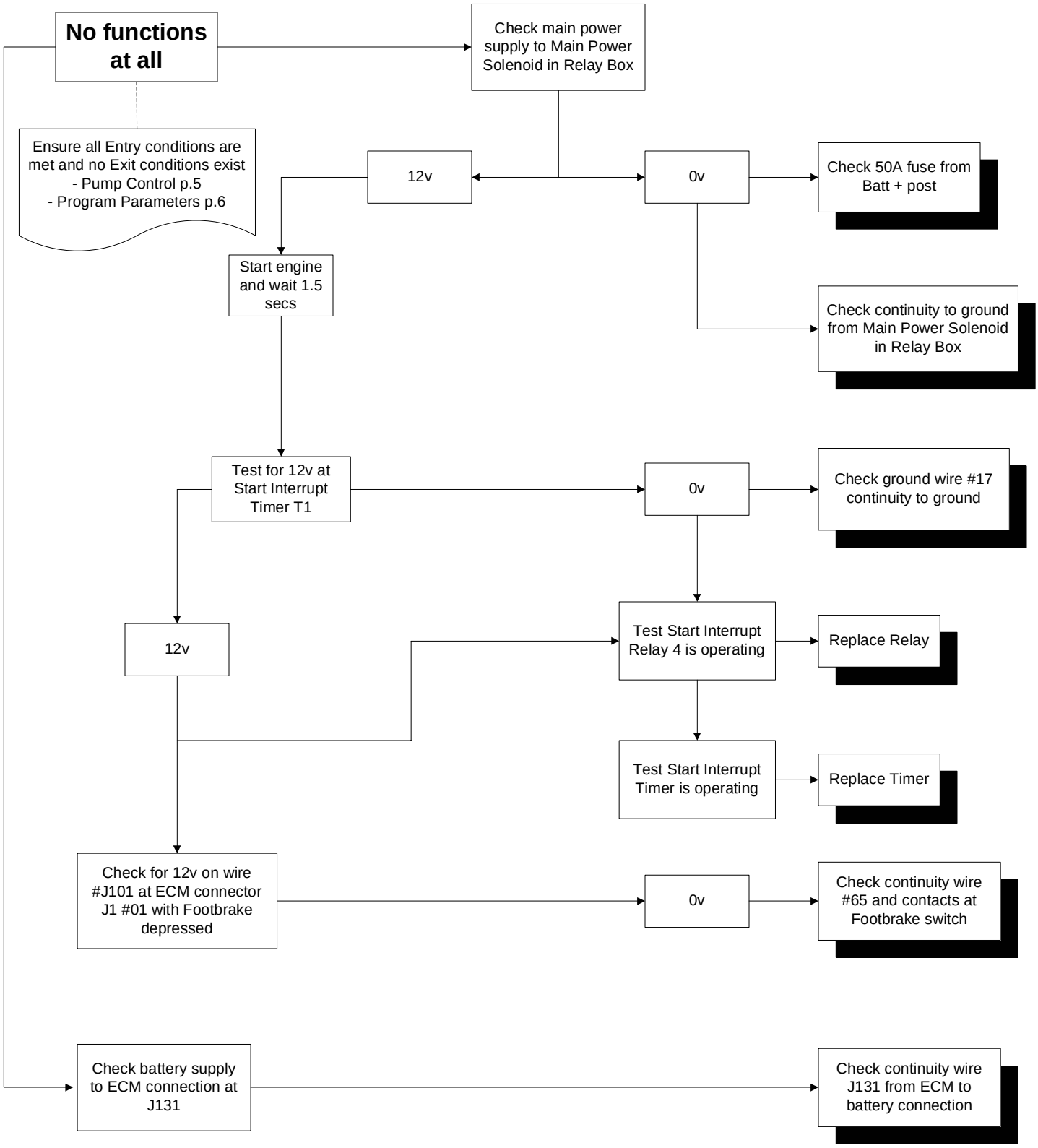
CAUTION

The main operating hydraulic valves are equipped for use with manual handles. These are supplied loose with the unit. Handles are for use by qualified maintenance personnel only and should not be left fitted to an operational unit. Use of the handles for system troubleshooting and verification will bypass all electrical lockouts, safety interlocks and operational cushions.
The handles can be used to quickly identify which part of the system is at fault, hydraulic or electrical. For example a handle may be fitted to the work section of the function in question. With the pump on, operate the handle and if the function is operating, then the fault lies in the electrical system.

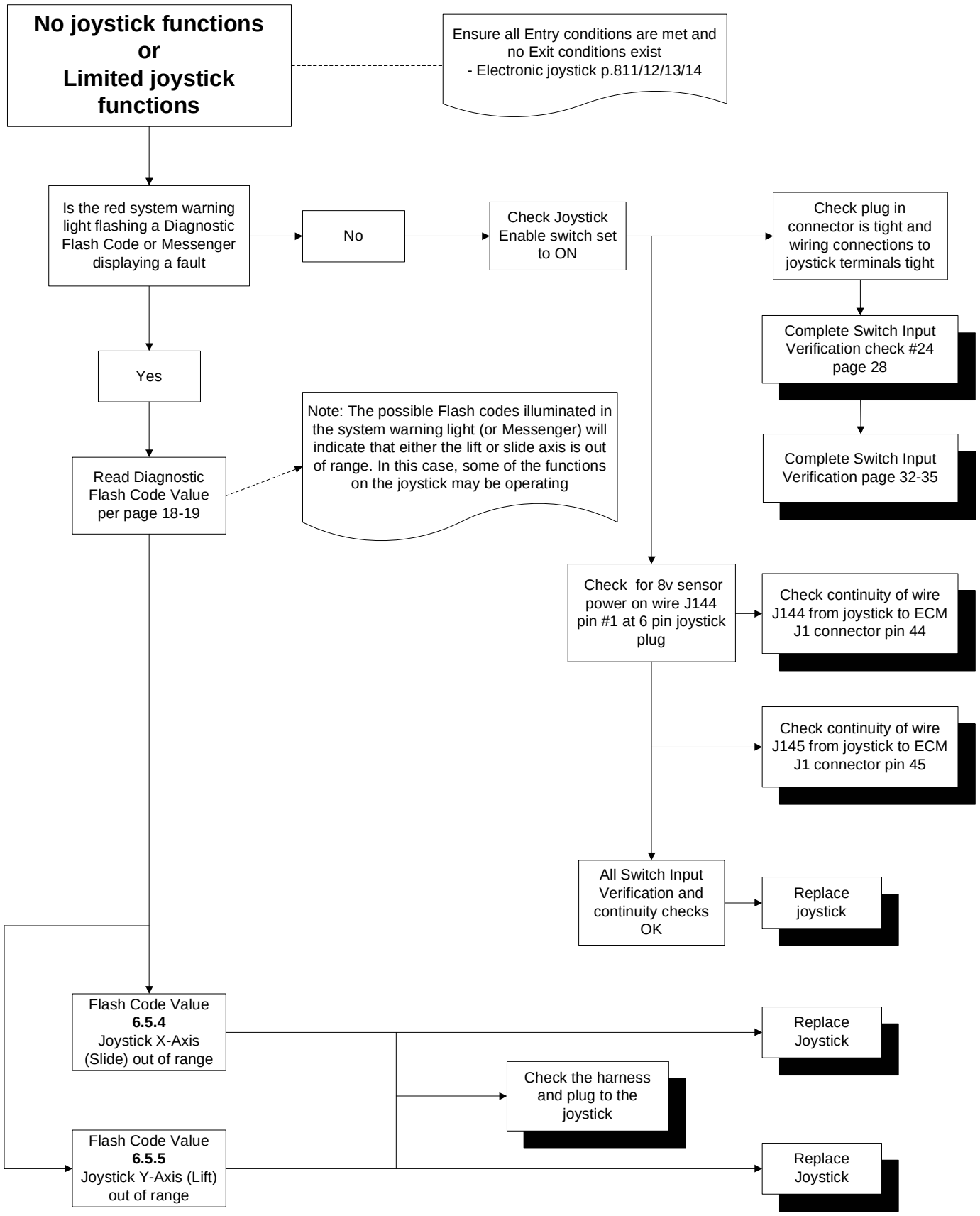
Troubleshooting Charts

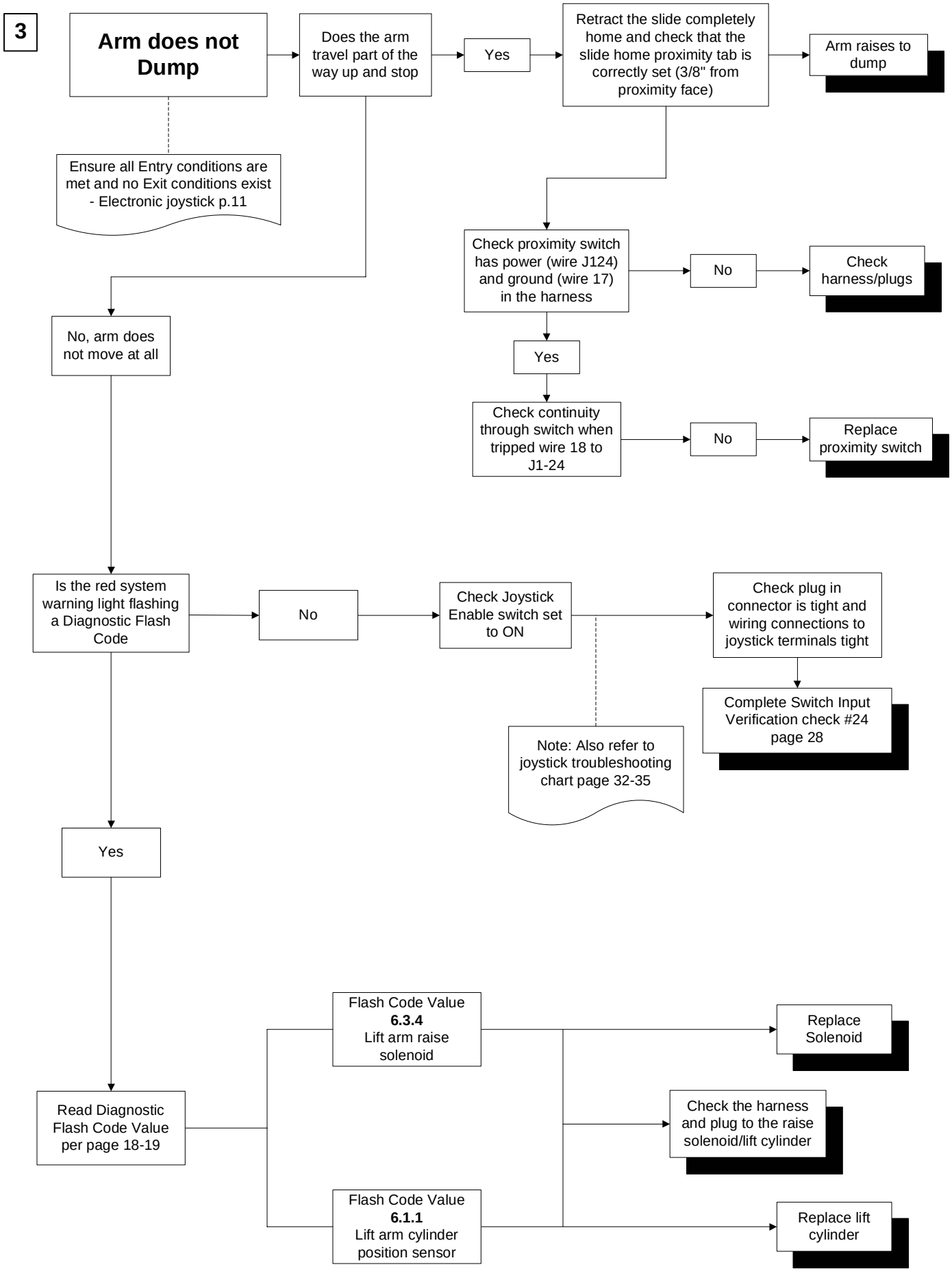
1. No functions at all
2. No joystick functions or limited joystick functions
3. Arm does not dump
4. Pendulum will not pack
5. Pendulum will not return

1

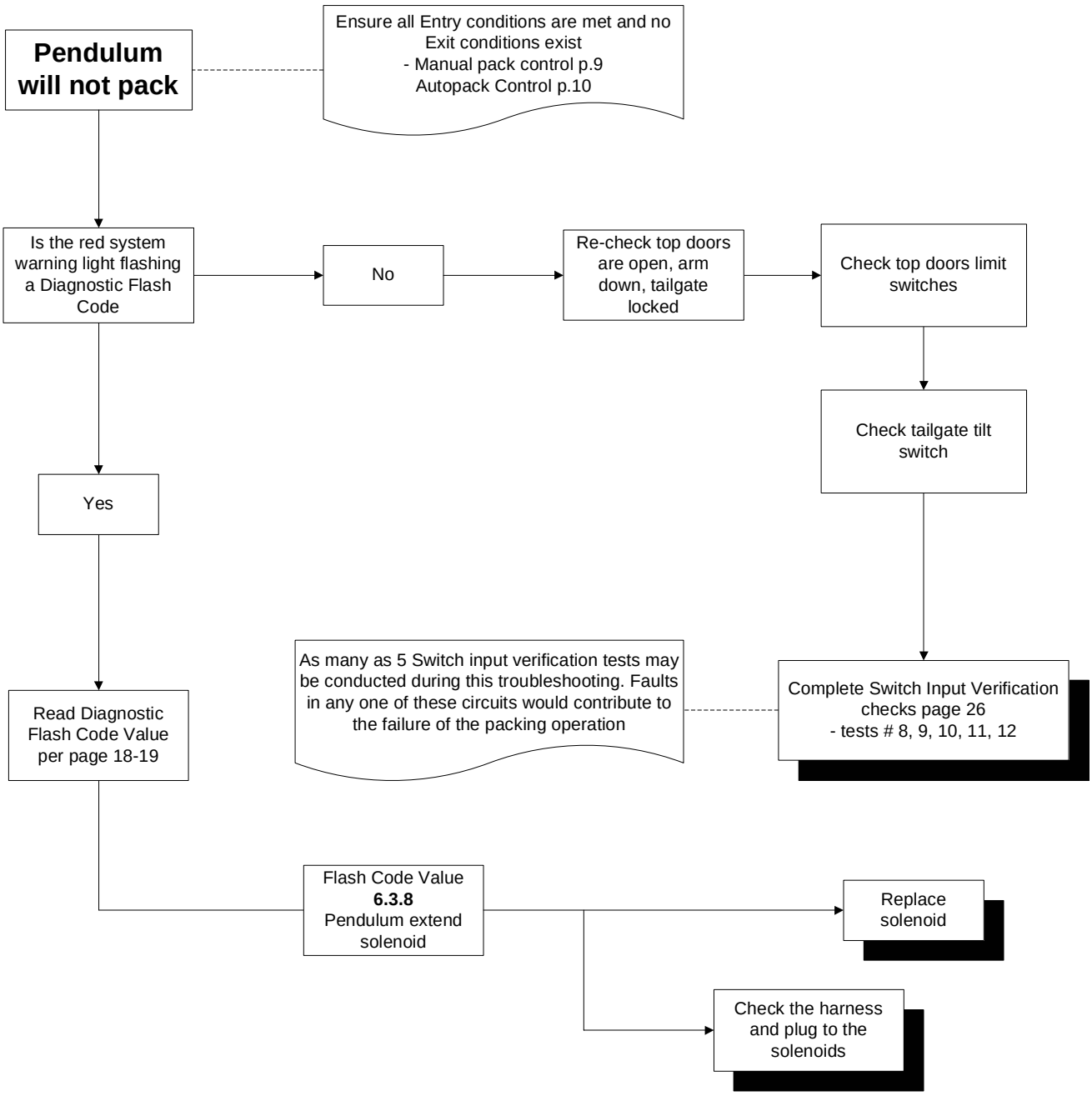

No functions at all
Check main power supply to Main Power Solenoid in Relay Box
Ensure all Entry conditions are met and no Exit conditions exist
- Pump Control p.5
- Program Parameters p.6
12v
0v
Check 50A fuse from Batt + post
Start engine and wait 1.5 secs
Check continuity to ground from Main Power Solenoid in Relay Box
Test for 12v at Start Interrupt Timer T1
0v
Check ground wire #17 continuity to ground
12v
Test Start Interrupt Relay 4 is operating
Replace Relay
Test Start Interrupt Timer is operating
Replace Timer
Check for 12v on wire #J101 at ECM connector J1 #01 with Footbrake depressed
0v
Check continuity wire #65 and contacts at Footbrake switch
Check battery supply to ECM connection at J131
Check continuity wire J131 from ECM to battery connection

2

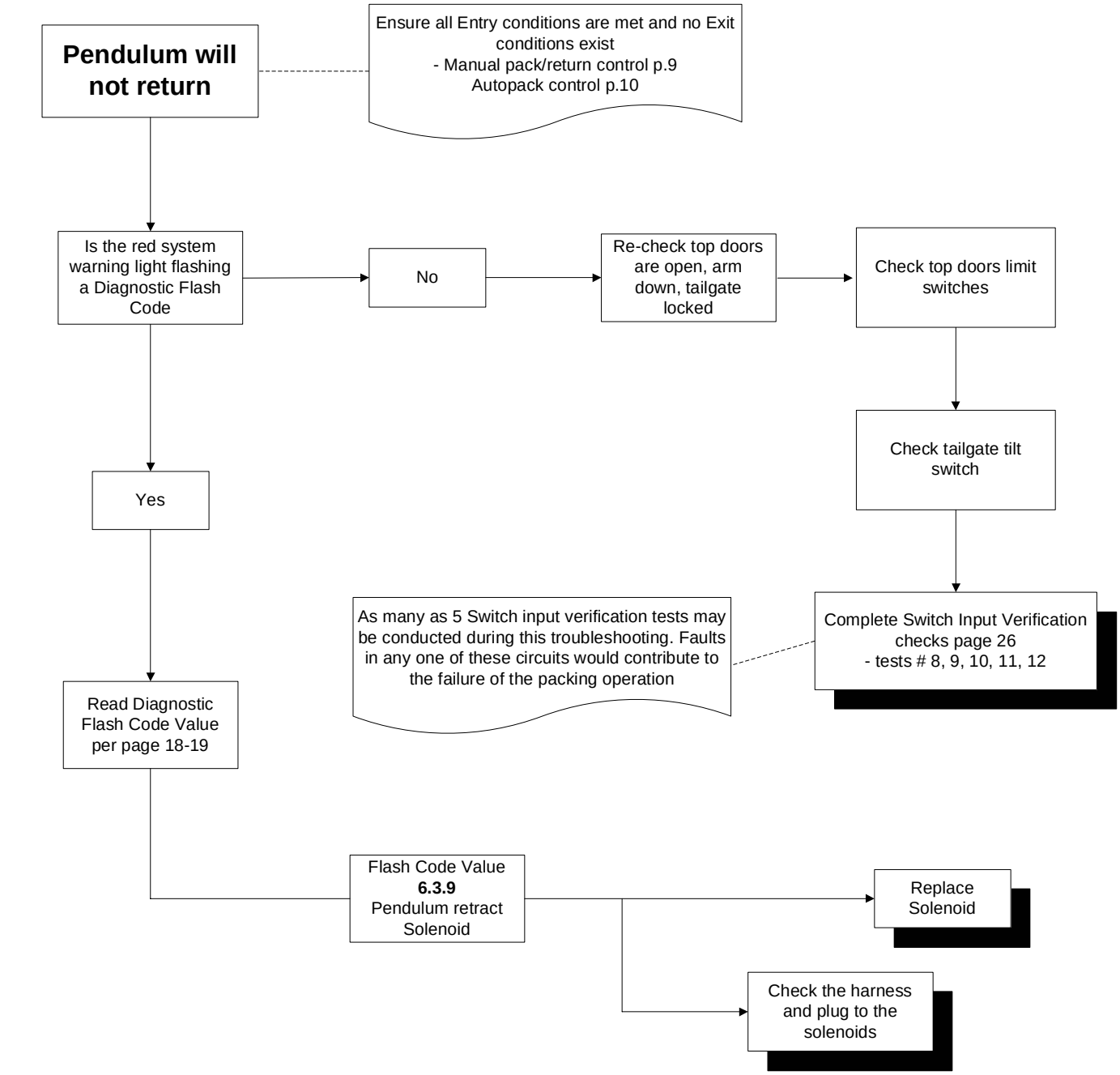

No joystick functions or Limited joystick functions
Ensure all Entry conditions are met and no Exit conditions exist - Electronic joystick p.811/12/13/14
Is the red system warning light flashing a Diagnostic Flash Code or Messenger displaying a fault
No
Check Joystick Enable switch set to ON
Check plug in connector is tight and wiring connections to joystick terminals tight
Complete Switch Input Verification check #24 page 28
Complete Switch Input Verification page 32-35
Yes
Read Diagnostic Flash Code Value per page 18-19
Note: The possible Flash codes illuminated in the system warning light (or Messenger) will indicate that either the lift or slide axis is out of range. In this case, some of the functions on the joystick may be operating
Check for 8v sensor power on wire J144 pin #1 at 6 pin joystick plug
Check continuity of wire J144 from joystick to ECM J1 connector pin 44
Check continuity of wire J145 from joystick to ECM J1 connector pin 45
All Switch Input Verification and continuity checks OK
Replace joystick
Flash Code Value 6.5.4 Joystick X-Axis (Slide) out of range
Replace Joystick
Check the harness and plug to the joystick
Flash Code Value 6.5.5 Joystick Y-Axis (Lift) out of range
Replace Joystick


3
Arm does not Dump
Does the arm travel part of the way up and stop
Yes
Retract the slide completely home and check that the slide home proximity tab is correctly set (3/8" from proximity face)
Arm raises to dump
Ensure all Entry conditions are met and no Exit conditions exist - Electronic joystick p.11
Check proximity switch has power (wire J124) and ground (wire 17) in the harness
No
Check harness/plugs
Yes
Check continuity through switch when tripped wire 18 to J1-24
No
Replace proximity switch
No, arm does not move at all
Is the red system warning light flashing a Diagnostic Flash Code
No
Check Joystick Enable switch set to ON
Check plug in connector is tight and wiring connections to joystick terminals tight
Complete Switch Input Verification check #24 page 28
Note: Also refer to joystick troubleshooting chart page 32-35
Yes
Read Diagnostic Flash Code Value per page 18-19
Flash Code Value 6.3.4 Lift arm raise solenoid
Replace Solenoid
Check the harness and plug to the raise solenoid/lift cylinder
Flash Code Value 6.1.1 Lift arm cylinder position sensor
Replace lift cylinder

4


Pendulum will not pack
Ensure all Entry conditions are met and no Exit conditions exist
- Manual pack control p.9
Autopack Control p.10
Is the red system warning light flashing a Diagnostic Flash Code
No
Re-check top doors are open, arm down, tailgate locked
Check top doors limit switches
Check tailgate tilt switch
Yes
As many as 5 Switch input verification tests may be conducted during this troubleshooting. Faults in any one of these circuits would contribute to the failure of the packing operation
Complete Switch Input Verification checks page 26
- tests # 8, 9, 10, 11, 12
Read Diagnostic Flash Code Value per page 18-19
Flash Code Value
6.3.8
Pendulum extend solenoid
Replace solenoid
Check the harness and plug to the solenoids

5


Pendulum will not return
Ensure all Entry conditions are met and no Exit conditions exist
- Manual pack/return control p.9
Autopack control p.10
Is the red system warning light flashing a Diagnostic Flash Code
No
Re-check top doors are open, arm down, tailgate locked
Check top doors limit switches
Check tailgate tilt switch
Yes
As many as 5 Switch input verification tests may be conducted during this troubleshooting. Faults in any one of these circuits would contribute to the failure of the packing operation
Complete Switch Input Verification checks page 26
- tests # 8, 9, 10, 11, 12
Read Diagnostic Flash Code Value per page 18-19
Flash Code Value
6.3.9
Pendulum retract Solenoid
Replace Solenoid
Check the harness and plug to the solenoids

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